UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	10/565,875
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Title	:	System & Method for determining attitude using spatial shift key (ssk) modulation signatures
Art Unit	:	3662
Examiner	:	Hien Ly

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
USA

January 23, 2008

Reply and Amendments in response to restriction requirement imposed in office communication dated January 3, 2008

Dear Sir,

1. Background

Receipt of your Office Communication dated January 3, 2008 regarding election restrictions under 35 U.S.C 121 for Application No. 10/565,875 is acknowledged.

2. Election

The invention defined in Group I is elected as the invention to be examined. In other words, claims 1 – 6 and 11 encompass the elected invention to be examined.

3. Amendments to the claims

Supplementary to elected claims 1 – 6 and 11, the claims are to be amended to include additional claims. Please amend the claims as follows. This listing of claims replaces all prior versions and listings of claims in the application.

1 (cancelled).

2 (currently amended). A method for determining attitude, the method comprising:

a) transmitting a signal through a radiating means which moves predeterminately through three-dimensional space, such that a cyclic Doppler is superimposed upon the transmitted signal;
b) receiving said transmitted signal through a receiving means which moves predeterminately through three-dimensional space, such that a cyclic Doppler is superimposed upon the received signal;
c) analysing the relative movement of said receive means to said radiating means by interpreting said cyclic Doppler ((said)) superimposed upon the received signal ((,)) ; and ((;))
d) determining the attitude of said receiving means based on said interpreted ((said))cyclic Doppler.

3 (currently amended). A method for determining attitude, the method comprising:

a) transmitting a signal through a radiating means which moves predeterminately through three-dimensional space, such that a cyclic Doppler is superimposed upon the transmitted signal;
b) receiving said transmitted signal at a receiving means which moves predeterminately through three-dimensional space, such that a cyclic Doppler is superimposed upon the received signal;
c) adjusting the movement of said receiving means to bring said cyclic Doppler ((~~said~~)) superimposed upon said received signal to a predetermined value ((,)) ; and ((;))
d) determining the attitude of said receiving means based upon the adjustment required.

4 (currently amended). The method of claim 3, wherein said ((a)) predetermined value of step (c) is a minimum.

5 (original). The method of claim 3, wherein said predeterminate movement of said receiving means in step b) is a replica of said predeterminate movement of said radiating means in step a).

6 (currently amended). A method for determining attitude, the method comprising:

a) transmitting a signal through a radiating means which moves predeterminately through three-dimensional space, such that a cyclic Doppler is superimposed upon the transmitted signal;
b) receiving said transmitted signal at a receiving means which moves predeterminately through three-dimensional space, such that a cyclic Doppler is superimposed upon the received signal;
c) analysing said cyclic Doppler ((said)) superimposed upon said received signal to determine a Doppler pattern ((,)) ; and ((;))
d) determining the attitude of said receiving means by matching said determined Doppler pattern to pre-defined Doppler patterns associated with known relative attitudes of said radiating means and said receiving means.

7 – 10 (cancelled).

11 (currently amended). A method for determining attitude, the method comprising:

a) transmitting a plurality of signals from a plurality of spatially distributed transmission means configured with at least one or more radiating means, said radiating means configured to move through three-dimensional space with identical predetermined

motion, with each of said plurality of signals assigned to one of said radiating means, such that an identical cyclic Doppler is superimposed upon each transmitted signal;

b) receiving said plurality of transmitted signal at a receiving means which moves predeterminately through three-dimensional space, such that a cyclic Doppler is superimposed upon the received signal;

c) adjusting the movement of said receiving means to bring said cyclic Doppler ((said)) superimposed upon ((the)) said received ~~signal~~ signals to a predetermined value ((,)) ; and ((;))

d) determining the attitude of said receiving means based upon the adjustment required.

12 – 18 (cancelled).

19 (new). A method for determining the attitude of a mobile apparatus, the method comprising the steps of:

a) transmitting a positioning signal through radiating means, said radiating means moving its phase centre through three-dimensional space with predefined motion at a predetermined interval, such that a first cyclic doppler is superimposed upon said positioning signal;

b) receiving said positioning signal through receiving means, said receiving means moving its phase centre through three-dimensional space with predefined motion at a predetermined interval, such that a second cyclic doppler is observed by said receiving means;

c) measuring a combined cyclic doppler observed by said receiving means, said combined cyclic doppler comprising said first cyclic doppler and said second cyclic doppler;

d) adjusting said predetermined interval of said receiving means, such that said combined cyclic doppler is minimised;

e) determining the attitude of said mobile apparatus based on said adjustment required, such that said receiving means and said radiating means are brought into spatial correlation.

20 (new). A method for determining the attitude of a mobile apparatus according to claim 19, wherein said predetermined interval of said receiving means is substantially similar to said predetermined interval of said radiating means.

21 (new). A method for determining the attitude of a mobile apparatus according to claim 19, said method further comprising the steps of:

a) dedicating a principal axis to said radiating means within a reference frame;

b) dedicating a principal axis to said mobile apparatus within its body frame;

c) dedicating a principal axis to said receiving means relative to said mobile apparatus principal axis;

d) measuring a time from when said receiving means phase centre traverses through said reference frame principal axis to when said receiving means phase centre traverses through said receiving means principal axis; and

e) calculating the attitude of said mobile apparatus principal axis based on said measured time and said relationship between said receiving means principal axis and said mobile apparatus principal axis.

22 (new). A method for determining the attitude of a mobile apparatus according to claim 19, said method further comprising the steps of:

a) dedicating a principal axis to said radiating means within a reference frame;

b) dedicating a principal axis to said mobile apparatus within its body frame;

c) dedicating a principal axis to said receiving means relative to said mobile apparatus principal axis;

d) measuring the angular offset of said receiving means principal axis with respect to said reference frame principal axis at the beginning of said predetermined interval of said receiving means; and

e) calculating the attitude of said mobile apparatus principal axis based on said measured angular offset and said relationship between said receiving means principal axis and said mobile apparatus principal axis.

23 (new). A method for determining the attitude of a mobile apparatus according to claim 19, said method further comprising the steps of:

a) measuring carrier phase measurements of said positioning signal at a receiver carrier phase measurement rate, said receiver carrier phase measurement rate being faster than said predetermined interval of said radiating means;
b) updating a carrier tracking loop within said receiving means at a receiver tracking loop update rate, said receiver carrier tracking loop update rate being slower than or equal to said predetermined interval of said radiating means;
c) comparing said carrier phase measurements to a digital controlled oscillator within said carrier tracking loop;
d) aggregating said carrier phase measurements to determine a combined cyclic doppler value.

24 (new). A method for determining the attitude of a mobile apparatus, the method comprising the steps of:
a) transmitting a plurality of positioning signals through a plurality of radiating means, each of said plurality of radiating means moving its phase centre through three-dimensional space with predefined motion at a predetermined interval, such that a first cyclic doppler is superimposed upon each of said plurality of positioning signals;
b) receiving said plurality of positioning signals through a plurality of receiving means, each of said plurality of receiving means moving its phase centre through three-dimensional space with predefined motion at a predetermined interval, such that a second cyclic doppler is observed by each of said plurality of receiving means;
c) measuring a plurality of combined cyclic doppler observed by said plurality of receiving means, each of said combined cyclic doppler comprising a first cyclic doppler superimposed upon one of said plurality of positioning signals and a second cyclic doppler observed by one of said plurality of receiving means;
d) differencing said first cyclic doppler from each of said plurality of positioning signals with said second cyclic doppler observed by each of said plurality of receiving means;
e) adjusting said predefined motion of said plurality of receiving means phase centres to match said predefined motion of said plurality of radiating means phase centres, such that said plurality of combined cyclic doppler is minimised;
f) determining the attitude of said plurality of said mobile apparatus based on said adjustment required.

25 (new). A method for determining the attitude of a mobile apparatus according to claim 24, wherein said adjustment brings said plurality of receiving means and said plurality of radiating means into spatial correlation.

26 (new). A method for determining the attitude of a mobile apparatus according to claim 24, wherein said predetermined interval of said receiving means is substantially similar to said predetermined interval of said radiating means.

27 (new). A method for determining the attitude of a mobile apparatus, the method comprising the steps of:
a) transmitting a positioning signal through radiating means, said radiating means moving its phase centre through three-dimensional space with predefined motion at a predetermined interval, such that a first cyclic doppler is superimposed upon said positioning signal;
b) receiving said positioning signal through receiving means, said receiving means moving its phase centre through three-dimensional space with predefined motion at a predetermined interval, such that a second cyclic doppler is observed by said receiving means;
c) continuously measuring a combined cyclic doppler observed by said receiving means, said combined cyclic doppler comprising said first cyclic doppler and said second cyclic doppler;
d) continuously matching said combined cyclic doppler with predetermined doppler patterns associated with said receiving means;
e) determining the attitude of said receiving means based on said matched predetermined doppler patterns.

28 (new). A method for determining the attitude of a mobile apparatus according to claim 27, wherein said predefined doppler patterns are stored in memory means of said receiving means.

29 (new). A method for determining the attitude of a mobile apparatus according to claim 27, said method further comprising the steps of:

a) measuring carrier phase measurements of said positioning signal at a receiver carrier phase measurement rate, said receiver carrier phase measurement rate being faster than said predetermined interval of said radiating means;
b) updating a carrier tracking loop within said receiving means at a receiver tracking loop update rate, said receiver carrier tracking loop update rate being slower than or equal to said predetermined interval of said radiating means;
c) comparing said carrier phase measurements to a digital controlled oscillator within said carrier tracking loop;
d) aggregating said carrier phase measurements to determine a combined cyclic doppler value.

30 (new). A method for determining the attitude of a mobile apparatus according to claim 27, wherein said carrier phase measurements of said positioning signal are in-phase and quadrature (I & Q) measurements.

31 (new). A method for determining the attitude of a mobile apparatus according to claim 27, wherein said predefined motion of said radiating means is contained in a volume within a radius of one-quarter of said positioning signal's wavelength.

4. Excess claims fees

The original set of claims comprised of 18 claims in total, 16 of which were independent. The currently presented claim set comprises of 19 claims, 7 of which are independent. The total number of claims is still under 20 and therefore there are no excess claim fees to be paid.

5. Traversal of requirement

The examiner's decision to group claims 7, 10 and 15 separately from claim 8 is traversed. The examiner explains that the invention defined in claims 7, 10 and 15 (group II) is distinct from the invention defined in claim 8 (group III). Applicant respectfully submits that claims 7, 10, 15 and claim 8 define the same invention as follows:

The invention defined in claims 7, 10 and 15 is primarily directed at:

- Transmitting a signal through a radiating means or two radiating means;
- Receiving that signal through **two receiving means** whereby
    - The first receiving observes a first cyclic Doppler superimposed upon the received signal;
    - The second receiving observes a second cyclic Doppler superimposed upon the received signal;
- A Doppler difference is determined by **differencing the first cyclic Doppler and the second cyclic Doppler**;
- **Movement of the two receiving means are adjusted** in order to minimise the Doppler difference; and
- The attitude of the receiver is determined based upon the adjustment required.

Similarly, the invention defined in claim 8 is primarily directed at:

- Transmitting a signal through a radiating means;
- Receiving that signal through **three receiving means** whereby
    - The first receiving means observes a first cyclic Doppler superimposed upon the received signal;
    - The second receiving observes a second cyclic Doppler superimposed upon the received signal; and
    - The third receiving means observers a third cyclic Doppler superimposed upon the received signal;
- A Doppler difference is determined by **differencing the first cyclic Doppler and the third cyclic Doppler**;
- **Movement of the first receiving means and third receiving means are adjusted** in order to minimise the Doppler difference;
- Movement of the second receiving means is adjusted to minimize the second cyclic Doppler; and
- The attitude of the receiver is determined based upon the adjustment required for all the receiving means.

The difference between the invention defined in claims 7, 10 and 15 and that of claim 8 is that claims 7, 10 and 15 define two receiving means and difference the first cyclic Doppler and the second cyclic Doppler whereas claim 8 defines three receiving means and differences the first cyclic Doppler and third cyclic Doppler. The difference resides in the number of receiving means and is merely an obvious variant. There is no difference in the inventive concept of differencing between two cyclic Doppler measurements and then adjusting the movement of the receiving means in order to minimise the Doppler difference. The minor difference in the number of receiving means does not change the inventive concept or effect the working operation of the invention.

For the reasons set out above, applicant respectfully submits that claims 7, 10, 15 and 8 define the same invention and hence belong in the same group.

6. Divisional Application

In light of the above remarks with regards to claims 7, 10, 15 and 8 belonging to the same group, applicant will, in due course, file a divisional application comprising of claims 7, 10, 15 and 8 and/or additional claims that are readable upon the invention defined in claims 7, 10, 15 and 8.

Sincerely,

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